MEASURED AND ESTIMATED GFR IN SEVERELY AND MORBIDELY OBESE PATIENTS: EFFECTS OF AGE, BMI AND DIABETIC STATUS

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Introduction

The worldwide epidemic of obesity is now recognised as a risk factor for chronic renal disease. Adequate estimation of renal function in these obese patients is thus essential. Currently, previous reports have shown that formulas are not validated in this population when BMI ≥ 35 kg/m².

The aim of this study was to analyse the performance of formulas and assess the determinants of glomerular filtration rate in a large cohort of severely obese population with BMI ≥ 35 kg/m².

Material and Methods

This study included 707 measured and estimated GFR in 605 severely or morbidly obese patients referred to the Department of Renal Function Study at the University Hospital in Lyon between 2003 and 2015 because of suspected renal dysfunction or before organ donation. GFR was estimated with the Chronic Kidney Disease and Epidemiology (CKD-EPI), Modification of Diet in Renal Disease (MDRD), Berlin Initiative Study 1 (BIS1) equations (for patients over 70 years old) and measured with a gold standard method (inulin or iohexol) indexed to body surface area determined by the Dubois and Dubois formula with either actual (mGFRr) or adjusted (mGFRa) body weight. Mean bias (eGFR-mGFRr) and accuracy of eGFR were compared in the whole population and between subgroups of age, BMI, diabetic status as potential factors influencing mGFR or eGFR.

Results

Characteristics of patients

Median BMI was 38.3 kg/m² and median mGFRr was 50 ml/min/1.73m² (Table 1). Three hundred and twenty five patients were diabetics. Diabetic patients were older than non-diabetics and had a lower GFR.

Patient's characteristics (n = 605)	
Men, *n* (%)	314 (52)
Age (yr)	58.3 (18.2-86.9)
Body Mass Index (kg/m²) >40, *n* (%)	38.3 (35-67.1) 238 (39%)
Body Surface Area (m²)	2.09
Creatinine IDMS (µmol/l)	122
Diabetics, *n* (%)	325 (54%)
Hypertension, *n* (%)	439 (73%)
Renal function (ml/min/1.73m²)	
mGFRr	50 (8-173)
mGFRa	56.3 (9-191)
$eGFR_{CKD-EPI}$	56 (7-138)
$eGFR_{MDRD}$	55.2 (7-199)

Table 1: Patient's characteristics. Results are expressed as median (Min-Max)

Performance of eGFR

In the whole cohort, bias between $eGFR_{CKD-EPI}$ and mGFRr and mGFRa **were important** (10.8-11.8 ± 10.8-11.7 ml/min/1.73m²). **$eGFR_{CKD-EPI}$ had a better accuracy with mGFRa** compared to mGFRr (82% versus 78% respectively, p<0.01) (Table 2).

	CKDEPI-mGFRr	**CKDEPI-mGFRa**	P-value
Bias	10.8 ± 10.8	11.8 ± 11.7	**P<0.01**
Precision	11.5	11.8	**NS**
Accuracy	78%	82%	**P<0.01**

Table 2: Bias, precision and accuracy between CKDEPI and mGFRr or mGFRa

Morbidly obese patients

For morbidly obese patients defined by a BMI > 40, bias were important (11.4-15.6 ± 12.1-15.5 ml/min.1.73m²) but **not different** compared to the subgroup of **patients with a BMI between 35 and 40 kg/m².**

Patients older than 70

	> 70 ans n=103
Age (yr)	75,9 ± 4,1
Sex (female)	59 (49%)
Weight (kg)	100,6 ± 15,1
BMI (kg/m²)	39,7 ± 4,5
BSA (m²)	2 ± 0,2
HTA	86 (71%)
Diabetes	75 (62%)
creat IDMS (µmol/l)	142,2 ± 59,9
Renal function (ml/min/1.73m²)	
mGFRr	37,9 ± 16,1
CKD EPI	42,6 ± 17,1
BIS 1	40,9 ± 12,7
Absolute Bias (ml/min/1.73m²)	
BIS1-mGFRr	8.1 ± 6.0
CKD-EPI-mGFRr	9.0 ± 7.9
MDRD-mGFRr	10.0 ± 9.0

Table 3: Patient older than 70's characteristics
Results are expressed as Mean ± SD

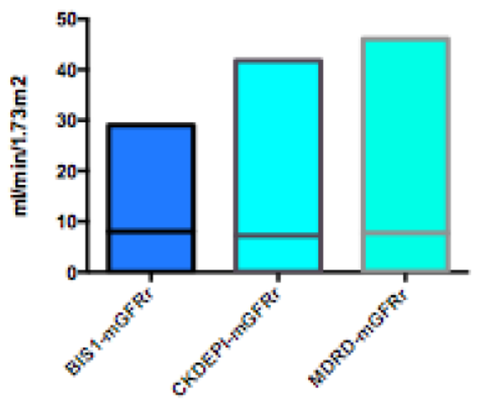

Figure 1: Bias comparison between BIS1, CKDEPI and MDRD with mGFRr

For patients over 70, bias with mGFRr were lower for $eGFR_{BIS1}$ than $eGFR_{CKD-EPI}$ and $eGFR_{MDRD}$ (8.1 versus 9,0 and 10.0 ml/min/1.73m² respectively ; p<0.01) (Table 3, Figure 1).

Diabetic patients

Diabetic patients were older than non-diabetics and had a lower GFR. There was no difference of bias or accuracy between $eGFR_{CKD-EPI}$ and mGFRr or mGFRa when comparing diabetic to non diabetic patients. (Table 4)

	Diabetics n= 325	**Non-diabetics** n=280	**P value**
Characteristics			
Age (yr)	61.1 ± 11.1	54.9 ± 13.4	**<0.001**
Sex (female)	182 (52%)	184 (56%)	0.26
Weight (kg)	105.4 ± 14.9	106 ± 16.1	0.61
Height (m)	163.2 ± 9.8	162.8 ± 9.9	0.64
BMI (kg/m2)	39.8 ± 3.9	39.7 ± 4.8	0.93
BSA (m2)	2.1 ± 0.2	2.1 ± 0.2	0.55
mGFRr (ml/min/1.73m2)	53.1 ± 29.0	61.8 ± 32.2	**<0.001**
$eGFR_{CKD-EPI}$ (ml/min/1.73m2)	56.7 ± 29.4	66.2 ± 30.8	**<0.001**
Accuracy CKDEPI-mGFR	77%	79%	0.57
Precision CKDEPI-mGFR	12	22	
Absolute Bias CKDEPI-mGFR	9.86 ± 9.95	11.28 ± 11.3	0.08

Table 4: Comparison between diabetic and non-diabetic patients.
Results are expressed as mean ± SD.

Conclusion

This study shows that indexation of mGFR with body surface area using adjusted body weight had a better accuracy with $eGFR_{CKD-EPI}$ than mGFR adjusted with body surface area using real body weight.
For obese patients over 70 years old, BIS1 had a better performance than MDRD or CKD-EPI equations when compared to mGFRr. Overall, estimation of GFR in obese population is not accurate whatever the severity of obesity, age or diabetic status.

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